Test Wednesday,

12/14

Faraday's Law:

- An induced emf is produced in a coil by changing the magnetic field.

$$\varepsilon = -\frac{\Delta \Phi_B}{\Delta t}$$

Φ_B → magnetic flux

ε → emf (units: V)

for 1 loop of a coil.

- if there are N loops,

$$\varepsilon = -N\frac{\Delta \Phi_B}{\Delta t}$$

- another way write:

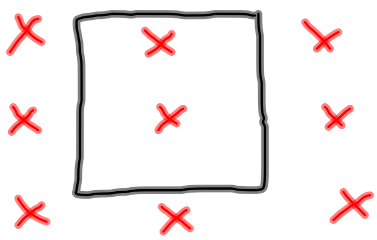
$$\varepsilon = -N\frac{\Delta (BA\cos\theta)}{\Delta t}$$

$$\varepsilon = -NA\cos\theta\,\frac{\Delta B}{\Delta t} = -NB\cos\theta\,\frac{\Delta A}{\Delta t}$$

$$= -NBA\frac{\Delta(\cos\theta)}{\Delta t}$$

- Way to induce emf:
  - change $\vec{B}$ with time
  - change A with time
  - change θ with time
  - Any combination of the three above

A coil consists of 200 turns of wire. Each turn is a square of side d = 18 cm, and uniform magnetic field directed perpendicular to the plane of the coil is turned on. If the field changes linearly from 0 to 0.50 T in 0.80 s, what is the magnitude of the induced emf in the coil while the field is changing?



$$\varepsilon = -NA\cos\theta \frac{\overbrace{\Delta B}^{(B_f - B_i)}}{\underbrace{\Delta t}_{(t_f - t_i)}}$$

$\theta = 0°$

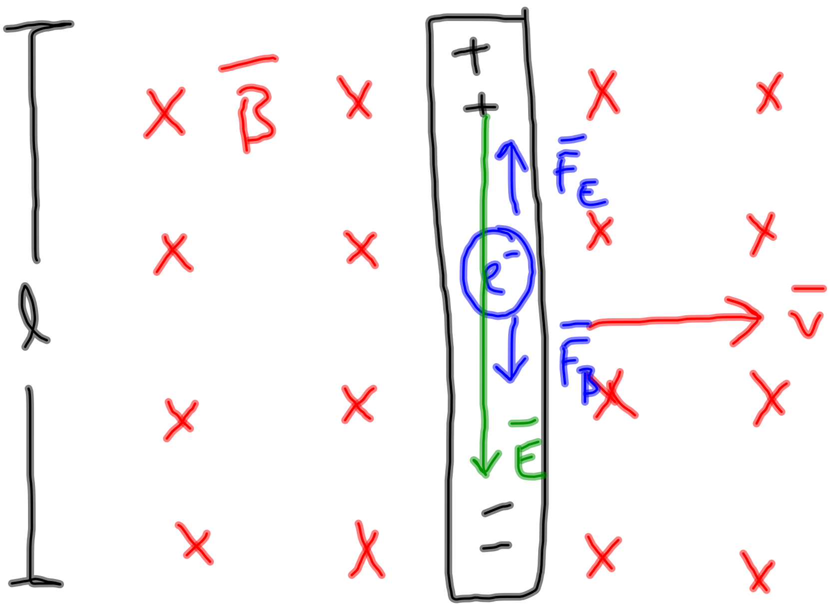
$$= \frac{-(200)(.18\text{ m})^2\cos(0°)(.5\text{ T})}{(.8\text{ s})}$$

$$= -4.05\text{ V}$$

On AP eqn. sheet:

$$\varepsilon_{avg} = -\frac{\Delta\phi_m}{\Delta t}$$

Motional emf:



- ΔV is maintained bet. ends of the bar as long as the bar is moving

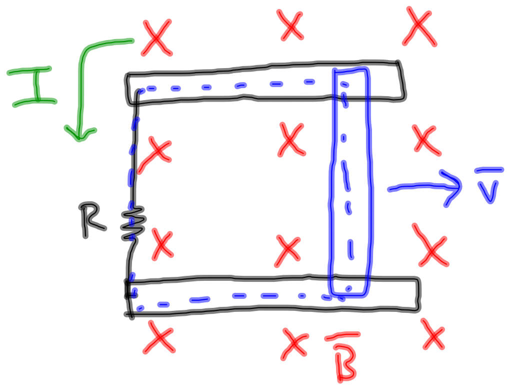
$$\mathcal{E} = -B\ell v$$

Lenz's Law:

$$\mathcal{E} = -\frac{\Delta \Phi_B}{\Delta t}$$

Lenz's Law

- Induced current in a loop is in the direction that creates a magnetic field that opposes the change in Φ_B through area closed by loop.



$$\mathcal{E} = -\frac{\Delta(BA\cos\theta)}{\Delta t}$$

$$= -B\cos\theta \frac{\Delta A}{\Delta t}$$

area is increasing